ADAPTIVE CONFOMITY ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORKS FOR LOAD BALANCING

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Abstract— The energy consumption is a great challenge in Wireless sensor networks that may affect the performance of the entire network. Even though many techniques are being still addressed to this issue, it is ongoing problem. One of the most energy efficient routing protocols is Geographic Adaptive Fidelity (GAF), which is the location based protocol. This reduces the use of energy by switching off some nodes that do not take part in routing. Load balancing reduces hot spots in sensor networks by spreading the workload across a sensor network there by increasing the life time of the sensor network. Here we use chebyshev sum metric for evaluation via simulation and this method is better compared to the routing based on Breadth first search(BFS) and shortest path obtained by Dijkstra's algorithm. By combining Geographic Adaptive Fidelity with load balancing, a considerable amount of energy can be saved that tends to extend the lifespan of the wholenetwork.

Index Terms— **wireless sensor networks; routing; energy efficient; load balancing.**

1. INTRODUCTION

Remote sensor systems (WSN) are a self association remote system framework used to gather information from a machine outfitted with sensor hubs, and forward information to the sink hub This framework is constituted by the spatially disseminated self-governing vitality restricted smaller scale sensor hubs furnished with detecting, registering, and with correspondence capacities [1]. Systems of sensors are agreeable to help a great deal of genuine applications that shift extensively regarding necessities and attributes[2].

As sensor systems scale-up in estimate, viably dealing with the appropriation of the systems administration load will be of incredible issue By spreading the workload over the sensor arrange, stack adjusting midpoints the vitality utilization. This may prompt expand the normal life expectancy of the whole system by broadening the time until the point that the primary hub is out of vitality. Load adjusting additionally be utilized for diminishing clog problem areas, along these lines decreasing remote impacts. Another testing issue is to spare the vitality of the hub [6]. When sensor organization is finished, it is difficult to supplant or energize the battery.

II.RELATED WORK

A variety of routing protocols have been proposed with different techniques to minimize the energy consumption and to increase the lifespan of the network. In [4], some of the techniques such as Data reduction, protocol overhead reduction, topology control, energy efficient protocols and Sleep/Active scheduling are focused. An example of single path load-balancing is Load-Balanced Ad hoc Routing (LBAR) algorithm proposed in [15] which uses traffic interference as a metric to distribute the network load and to avoid routing via heavily loaded paths. Multipath Routing Protocol (MSR) [16] is based on DSR and uses a Round Trip Time (RTT) to measure delays for different paths, which form the basis of its routing metric . In [6] , GAF protocol and it's working are considered. It also reviews the variety of new versions based on GAF protocol to make it better. Hierarchical Geographic Adaptive Fidelity (HGAF) is proposed to save the power of the nodes which increases the lifetime of whole network in[6].

Coordination-based data Dissemination protocol for wireless sensor networks (CODE) is proposed which is based on GAF protocol in [10] .In [11], TENT rule defines the method of finding the neighbor nodes with the angle and distance. HGAF uses a layered structure in which the entire area is divided into virtual grids. eHGAF extends the HGAF in which the place of the active sub cell is rotated. GAF & Co[12] maintain the connectivity of a network and avoids the routing tables. Some of the sensor network routing [17] [18] and QoS routing in Wireless ad hoc networks[19] ignore the load balancing issues. In many works such as in [20] [21] consider the base station as a resource rich focal point hosting the services such as securing the sensor network against vulnerabilities[22], data aggregation or monitoring of WSNs. Another protocol Energy efficient and Collision Aware (EECA)[23] takes energy of the nodes into account and it tries to avoid collision by choosing distant route paths.

III. GEOGRAPHIC ADAPTIVE FIDELITY (GAF)

Geographic Adaptive Fidelity or GAF [6][7] is vitality mindful area based steering calculation .It is at first intended for portable specially appointed systems, however these days utilized as a part of sensor arranges also. Hubs utilize area data through an y framework like GPS, got radio flag quality and so forth to find itself alongside its closest neighbors. In GAF convention, every hub partners itself with a virtual matrix so the whole range is partitioned into a few square frameworks, and the hub with the most noteworthy lingering vitality inside every lattice turns into the ace of the network. Determination of legitimate size assumes a key part as it straightforwardly influences the availability of the system. In the event that the matrix estimate is expansive then it is hard to associate the entire system by enacting only one hub for every frame work. The measure of framework (r) depends on the idea that any hub can speak with some other hub show in the neighboring matrix. The framework measure r will be $r \leq R/\sqrt{5}$ Where R is the radio range. Two hubs are thought to be proportionate when they keep up a similar arrangement of neighbor hubs and they can have a place with a similar correspondence courses. Source and goal in the application are barred from this portrayal.

A. Routing over GAF

Figure 1 demonstrates a virtual framework. Considering that there are five hubs 1 through 5. Hub 1 can speak with Node 5 with the assistance of sending the information to any of the middle of the road hubs in particular 2, 3 and 4. To limit the vitality utilization two hubs (3 and 4) from a similar framework rest mode. Still it is conceivable to send the information from 1 to 5 through 2. This is called as steering loyalty where the source and goal hubs are imparting utilizing just a single proficient hub as their directing accomplice and other halfway hubs go into rest mode.

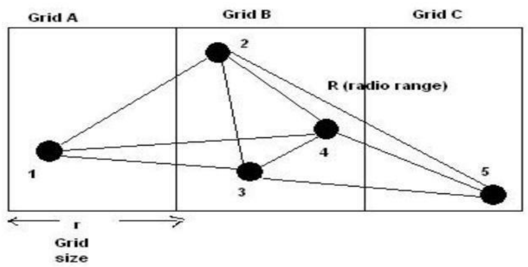


Fig.1.Vitrual grid in

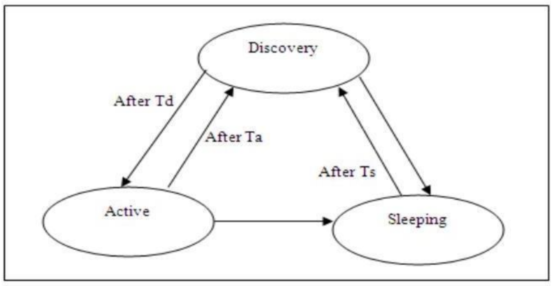


Fig.2.Transition states in GAF protocol

Before the leaving time of the active node expires, sleeping nodes wake up and one of them becomes active. Initially every node starts with the discovery state and then enters into active or sleep state.

State Transition from Discovery to Active

In the disclosure state, if hub gets some other revelation message from another hub having higher vitality level than a hub goes into the rest state. With a specific end goal to keep the directing constancy; dozing neighbors change their resting time (Ts) as needs be. One of the resting hubs ends up plainly dynamic much before the leaving time of the dynamic hub lapses.

- State Transition from Active to Sleeping is a dynamic time of the sensor hub which demonstrates that for to what extent a hub will remain in a dynamic state. After Ta , if another hub having high vitality is available in the lattice then current dynamic hub will goes into a rest state.

- State Transition from Sleeping to Discovery

To go into the disclosure stage, the hub needs to finish the rest time Ts . After Ts hub again goes into a disclosure stage and in the event that it has most astounding vitality level at that point goes into dynamic state else re-goes into rest state.

- State Transition from Active to Discovery

B. Transition states in GAF

Any sensor hub can be in three unique states in particular dozing, Discovery and Active state as appeared in fig.2. Just a single hub for each lattice can be in dynamic state and others go to resting mode to moderate the vitality. A hub to be in a dynamic state is chosen in light of its leftover vitality and this dynamic hub is in charge of observing, steering and revealing information from and to the sink. The dozing neighbors modify their After a predefined time Ta , a hub goes into the disclosure stage and rebroadcasts the revelation message for time Td . In the event that it gets a message from another hub having higher remaining vitality then it go into rest state else re-goes into dynamic state.

IV. LOAD BALANCING IN ROUTING PROBLEM

Load adjusted calculations are at first utilized to take care of system clog issue to enhance bundle conveyance proportion and to decrease parcel conveyance. Be that as it may, these days these calculations are likewise be utilized for vitality protection . Entirely are two classes of load adjusted steering calculations name single way and multipath stack adjusted directing calculations. In single way, it finds various ways from a source to goal however will just utilize the best way for routing.Eg.Load Balanced Ad-hoc steering (LBAR). Then again, in multipath stack adjusted directing, it circulates the information parcels over numerous ways for a solitary stream Eg.Energy Balanced Dynamic source steering(EB-DSR)[13].

The WSN directing tree is established in the base station and the sensor hubs includes its upstream parent in the tree. In this manner the sensor hubs closest to the base station will be the most vigorously stacked. The objective of load adjusting is to equitably appropriate the parcel movement produced by the sensor hubs over the diverse branches of the directing tree. A most limited way directing calculation executed on a sensor system may bring about a briefest way tree that can limits the jump ch ecks yet yielding a profoundly lopsided tree[3].This is on account of the choice of most brief way does not ensure for the heap accumulation on upstream hubs. In stack adjusted tree, the base station at the base of the tree expect the uniform network, producing the equivalent measure of load on each of the branches exuding from the root. Figure 3 demonstrates the lopsided briefest way tree and best level adjusted tree. Load adjusted trees might be arranged into three unique classifications, for example, completely adjusted, top-level adjusted or chain of importance adjusted. A completely stack adjusted tree is a spine tree for an arrangement of burdens to such an extent that, for each tree hub with different branches, all the branches convey a similar aggregate sum of burdens. A best load-adjusted tree is a spine tree for an arrangement of burdens with the end goal that, for the tree hub that has numerous branches and is nearest to the root, all the branches convey a similar aggregate sum of burdens. A chain of command adjusted tree is a tree in which the branches in specific levels convey a similar measure ofload.

V. LOAD BALANCING ALGORITHM OVER GAF (LB-GAF)

Load Balanced over Geographic versatile loyalty works in three phases

Step 1.Applying the heap adjusted calculation to change over the diagram of sensor arrange into adjusted tree structure.

Step 2: Applying the alteration calculation to rebalance the tree by moving the edges from the vigorously stacked branches into daintily stacked branches.
Step 3: Implementing GAF directing over the tree where the hubs partake in steering alone exchanged on.

This part manages the development and change of the best level adjusted tree for WSN considering Chebyshev total disparity as load adjusting metric.

The fundamental calculation for stack adjusting iteratively grows a heap adjusted tree outwards from the base station or sink. This algorithm watches the hubs creating the best load to the lightest branches to accomplish adjust. Watching the heaviest hubs at the prior keeps up the best adaptability for future adjust though watching them toward the finish of the calculation could prompt exceedingly lopsided trees. This calculation chooses the unmarked outskirt hub with the best development space when there are various heaviest fringe hubs.

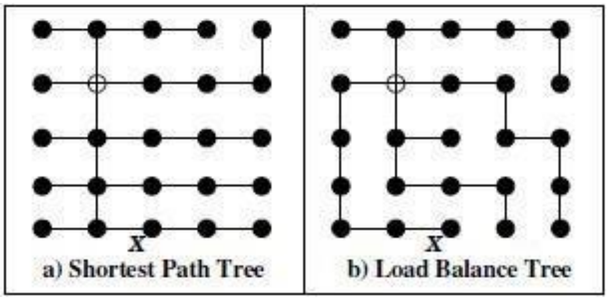


Fig.3.a) Unbalanced shortest path tree Vs Top-level balanced tree.

The Pseudo code for the algorithm is shown below.
M<= All nodes;

While (M ≠ Empty) do
//Select the lightest branch B=B [0];
For each B[i] do
if (weight (B)> weight (B[i]) B<=B[i];
else
B<=minFreedom (B[i], B);

//Select the heaviest border node with most growth space

$_1$ =n_o <=N, where N is B's border node list for each n_i <=N if Weight(n_1)≠Weight(n_i) n_1 <=heavier (n_1, n_i); else
n_1 <=maxFreedom (n_1, n_i) //graft nodes and update metrics T=T+ { n_1 }

N=N-{ n_1 } M=M-{ n_1 }
For each unmarked border node i of n1 N=N+{i};
done.

The base station or sink identifies the initial topology and load information about the sensor nodes and sensor network and computes the backbone tree from graph G. T is the current tree; B[i] represents the branches array; B is the selected branch, N [ ] refers to the list of the border nodes for each branch and M is the set of unmarked nodes.

A growth space of a node is the measure of the freedom to grow the tree towards this node. The greater the growth space, the more open area to expand the load balanced routing tree through this node. The growth space of the node can be calculated as the sum of number of unmarked neighbors of all the node's unmarked neighbors minus commonlinks.
Figure 4 shows the unmarked neighbors and the calculated growth spaces for each node. For example in the figure node Z

has two unmarked neighbors to its right and bottom. The growth space of Z can be calculated as 3+3-2(common links) =4. The growth space of a branch is defined as the sum of the growth spaces of all nodes within the branch.

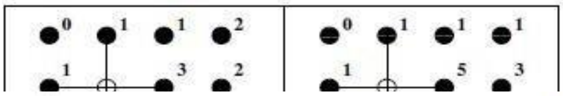
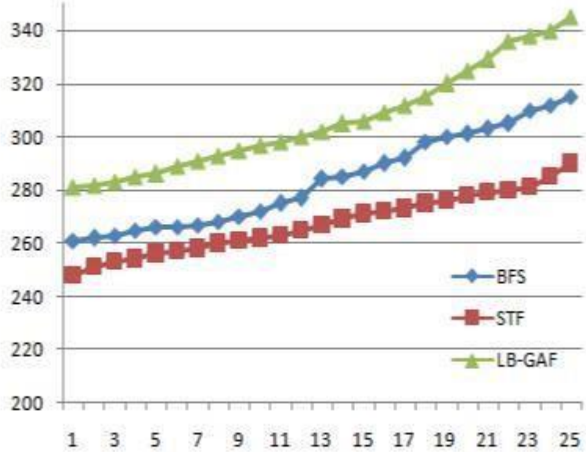


Fig.4.a) Number of unmarked neighbors of each node, b) Growth space of each node

As the fundamental calculation creates a generally stack adjusted tree at the best level, it requires a calculation to accomplish additionally adjusting .There are a few change calculations are accessible, for example, irregular adjustment[14] and winding adjustment[3]. Previous is oblivious to the topology data while the last uses the topology data. Subsequent to applying the fundamental calculation, the modification calculation is connected to iteratively rebalance the tree by moving the hubs from the heaviest stacked branches to all the more daintily stacked neighboring branches. The Spiral change calculation pivots through each of the tree's best level branches. It either pushes the neighbors from vigorously stacked to daintily stacked branches or pulls the neighbors to softly stack from intensely stackedbranches.

Rest Doze Co-appointment (SDC) [8][9] convention over GAF builds the lifetime of the system by turning off the sensor hubs that don't participate in information transmission. There are 2 modes at every hub to be specific "ON" period or "OFF" period. In ON period the sensor hub stays in its Alert mode or Doze mode and in OFF period it is in rest mode. Snooze is a sit still listening state and just a single hub for each network is in Doze state while the lay on the sensor hubs in the matrix stays in rest state. A hub changes its state from snooze to dynamic once its cradle gets loaded with information messages. After changing its express, the dynamic hub initially sends the guide message to enact the neighbor hubs and afterward sends its support content for addition ally preparing. Despite the fact that it builds the system lifetime by 20% over GAF convention, it is a costly technique as it needs a cradle.

In our calculation after the tree got adjusted, a variety of the above convention is actualized. There are some leaf hubs in the adjusted tree just through the entrance and departure ways are set. The way might be either from the root to the leaves the outward way for information transmission or from the leaves to the base station or root for information gathering. All sensor hubs can be in any of the three states to be specific rest, sluggish and intelligent. Leaf hubs are dependably in a nap at the end of the day sit out of gear listening state .It is sufficient to keep just a single hub in this nap state especially the leaf hub through which the information transmission begins. Remaining sensor hubs in the way up to the BS are in the rest state. Once the leaf hub distinguishes that its support is loaded with information, it changes its state from snooze state to intuitive state. Leaf hub alarms its neighbor by exchanging its support substance to its neighbor's cushion and goes into snooze state. After getting the information content in the cradle, the neighbor hub changes its state from tired to interactive,transfers its cushion substance to its neighbor and goes into drowsy



state. In this manner the information is directed towards the base station. The sensor hubs on the way enters in to rest state, once the information content leaves its support aside from leaf hubs that goes into nap state which again tunes in for information.

VI. EXPERIMENTALRESULTS

In this segment we assess and look at different calculations utilizing the test system ns-2. The execution measures of intrigue in this examination are a) Balance factor; b) Network life time.

A. Equalization factor

At first we assess the heap adjusting execution of our calculation with most brief way tree (SPT) and the tree made by BFS. Dijkstra's Algorithm utilizing a connection cost of 1 is represented each connect to locate the most brief way tree. The BFS calculation

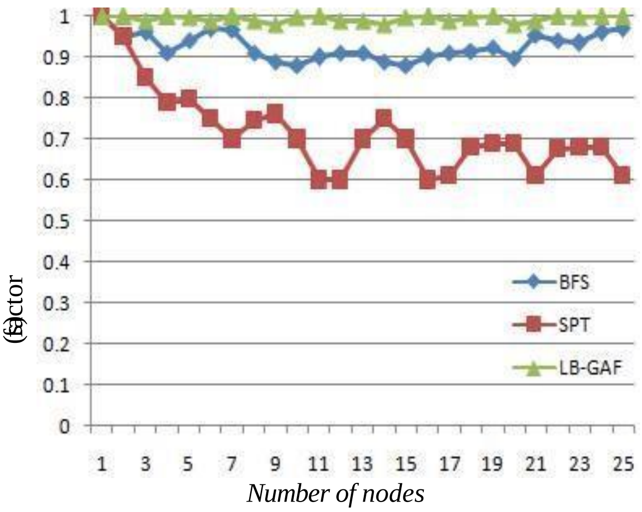
develops the tree from the root in a rotational premise between branches. Every one of the hubs in the Nth level are affixed and stamped gone to before adding N+1 level from the root.

Figure 5 survey the adjust factor of the steering trees created by the three calculations. By considering uniform load appropriation, for the square lattice estimate as 20 X 20, the analysis is executed for 25 times. From fig.5, it is demonstrated that the briefest way calculation creates the most uneven trees while our LB-GAF beats both SPT and BFS.

B.Network life time

System life time is the essential metric of intrigue. There are numerous definitions for organize lifetime, for example, time to whichthe system is parceled, time to which information conveyance rate falls beneath a predefined esteem, or time to which a pre- characterized number of hubs depleted.

Here we consider the most widely recognized definition for arrange life time, which is the term from the earliest starting point of the system operation to first hub disappointment. Figure 6 demonstrates the life time of 25 hubs plotted against the time span. It is evident that LB-GAF is substantially more vitality adjusted that can be seen from the hub life times. It likewise has the longest system life time contrasted and different calculations.



factor

Fig.5. Comparison of balance factor.

Number of nodes getting failed

Fig.6. Number of nodes getting failed against time.

VII. CONCLUSION

In this paper, we give a heap adjusted – Geographic Adaptive Fidelity directing convention for remote sensor systems. Initially, the lopsided system is changed over into a heap adjusted tree structure. Subsequent to building up a heap adjusted tree, a variety of rest Doze coordination convention of GAF is connected to ration vitality. Our calculation accomplishes extensively preferable adjusted trees over BFS and SPT. The outcomes from reenactments have demonstrated that LB-GAF can adequately drag out the system lifetime by expending less vitality from the sensor hubs.

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